

Report To The Congress OF THE UNITED STATES

Federal Agencies' Maintenance Of Computer Programs: Expensive And Undermanaged

Federal agencies spend millions of dollars annually on computer software (program) maintenance but little is done to manage it.

GAO studied 15 Federal computer sites in detail, and received completed questionnaires from hundreds of others. All reported large maintenance efforts but few had good records and very few managed software maintenance as a function.

Improvements can and should be made both in reducing maintenance on existing software and in constructing new software to reduce its eventual maintenance costs.

The National Bureau of Standards should issue a standard definition and specific technical guidelines for software maintenance. Heads of Federal agencies should require their automatic data processing managers to manage software maintenance as a discrete function.



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FEBRUARY 26, 1981

COMPTROLLER GENERAL'S REPORT
TO THE CONGRESS

FEDERAL AGENCIES' MAINTENANCE OF
COMPUTER PROGRAMS: EXPENSIVE AND
UNDERMANAGED

D I G E S T

Computer software maintenance consumes a large share of the Federal Government's automatic data processing (ADP) resources. After computer programs are put into operation, maintenance may be needed to make them do more or different tasks, to remove defects, or to reduce operating costs. GAO found that software maintenance has not received management attention appropriate to its cost and complexity.

GAO reviewed computer software maintenance in detail at 15 Federal computer sites and found their total annual maintenance costs to be \$33 million--\$19 million in programmer salaries, \$8 million in other salaries, and \$6 million in computer time. Two-thirds of the programmers at the 15 sites spent their time on maintenance. The Director of the General Services Administration's Software Development Office has estimated that the Government spends at least \$1.3 billion annually on software maintenance. (See p. 6.)

In spite of the high cost, agencies have a very limited overview of their software maintenance operation and have made little concentrated effort to effectively manage and minimize the resources required to maintain their computer software.

Maintenance is not managed as a function. That is, ADP managers have done little either to identify common causes of maintenance problems or to take action to reduce maintenance costs. The absence of maintenance management is due in part to (a) the absence of a uniform definition of maintenance, and (b) the absence of Government-wide guidance on how to control software maintenance and reduce its costs.

Managers generally have neither cost accounting data nor management data on software maintenance activities and thus know little about how much maintenance really costs overall, or which types of maintenance cost the most. Agencies have established no goals and standards to measure the

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efficiency of their maintenance operation, nor criteria for acceptable maintenance costs for given situations. They have made only limited use of improved tools and techniques which could reduce maintenance costs.

Software maintenance seems to be a common problem for all ADP users. The private sector reports that large percentages of its ADP resources are consumed by software maintenance.

Increased management attention to several problem areas could reduce costs. Inadequate emphasis in these areas appears to increase the maintenance workload either by requiring that extra maintenance be performed, or by detracting from the efficiency of maintenance that must be done.

Modifications account for about half of the total maintenance workload. While some modifications must be done to adapt software to changing user needs and prolong its useful life, others occur only because user needs were not properly identified in the first production version of the software. (See p. 17.)

Software is often maintained by people who did not develop it. If the documentation they need to understand the software is inadequate or missing, they must work harder to maintain the software. Poor documentation can increase the time to understand and maintain software applications, or lead to the redesign and rebuilding of an entire system of programs because understanding and modifying an existing program may be more trouble than building a new one. (See p. 23.)

Most data processing managers interviewed were of the opinion that contractor-developed software required more maintenance. Numerous questionnaire respondents indicated that they agreed with that opinion.

Questionnaire respondents selected better use of tools and techniques as the second most effective way to reduce maintenance. GAO has found that software tools and techniques--despite their

ability to improve the maintenance operation--are not used to their full potential at many agency data processing installations. 1/

Some organizations in the private sector have reported maintenance improvements achieved through better design and quality control in program development, increased use of tools and techniques, better documentation, and personnel-oriented measures including rotation and cross-training. (See p. 26.)

GAO developed a Provisional Checklist for Software Maintenance Management, shown in appendix I to this report. The checklist will be useful to organizations doing software maintenance.

CONCLUSIONS

Software maintenance in the Government is now largely undefined, unquantified, and undermanaged. Agencies need to develop and implement policies and procedures which will increase maintenance efficiency and ultimately reduce the amount and cost of software maintenance required. To help agencies in these efforts, standard definitions of the components of software maintenance and guidance on how to reduce its cost are needed.

RECOMMENDATIONS

GAO recommends that the Secretary of Commerce, through the National Bureau of Standards, develop and publish:

- Standard definitions of the component parts of software maintenance to aid agencies in recording and managing it.
- Specific guidance on software maintenance, detailing both how to improve maintenance of existing programs and how to construct new programs to reduce their eventual maintenance. GAO offers its provisional checklist pending action by the National Bureau of Standards.

1/"Wider Use of Better Computer Software Technology Can Improve Management Control and Reduce Costs" (FGMSD-80-38, Apr. 29, 1980).

GAO further recommends that heads of Federal agencies:

- Begin to manage software maintenance as a discrete function.
- Take measures to identify the amount of resources currently expended on software maintenance.
- Develop maintenance goals and standards as criteria to determine the efficiency and effectiveness of their software maintenance operation.
- Implement management policies and procedures to increase the efficiency of the maintenance operation and reduce future maintenance.
(See app. I.)

AGENCY COMMENTS

We asked for comments from the Department of Commerce, the General Services Administration, and the parent agencies of the 15 sites at which we analyzed software maintenance in detail--listed in appendix IV. The Department of Commerce failed to furnish comments in time for inclusion in the final report. The General Services Administration, the Postal Service, and the National Aeronautics and Space Administration furnished comments in time for inclusion.

The General Services Administration (GSA) agreed with GAO's conclusions and recommendations, agreed with the definition of software maintenance, and said that they plan to assist the National Bureau of Standards in any way possible to provide guidance to Federal agencies concerning software maintenance. GSA clarified its estimate of Federal software maintenance costs by explaining that the costs do not include the software used in embedded weapons system computers.

The Postal Service agreed with GAO's overall recommendations and said that it already has measures underway in keeping with GAO's recommendations to the heads of Federal agencies. The National Aeronautics and Space Administration (NASA) expressed its concern that the definition

does not apply to its software, which is mostly used in a research and development environment. In the light of GSA's comments and NASA's concerns, GAO clarified certain details of its presentation for this final report. The changes made were not substantive. (See app. V and p. 6.)

The other agencies from whom GAO requested comments failed to respond within the 30-day period required by Public Law 96-226.

ROUTING AND RECORD SHEET

SUBJECT: (Optional)

Software Maintenance

DD/A Registry

81 0708

FROM:

D/ODP/DDA
2-D-00 HQS.

EXTENSION

NO.

DATE 5 MAY 1981

TO: (Officer designation, room number, and building)

EO/DDA

5 MAY 1981 DATE 6 MAY 1981

RECEIVED

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OFFICER'S
INITIALS

COMMENTS (Number each comment to show from whom to whom. Draw a line across column after each comment.)

1. ADDA, BX-4

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Bill:

2. D/ODP

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J

Apropos our conversation last week about the importance of software maintenance, and perhaps reinforcing my contention that considerations regarding efficient maintenance are more important than the efficiency of the software, I attach a copy of the digest of a recent GAO report on Maintenance of Computer Programs which, they contend, is both expensive and undermanaged in the Federal government. CIA appears to be ahead of its competition in addressing a problem which is clearly of great concern to the Comptroller General. We do, in fact, cover maintenance as a separate function and track its costs. There are several suggestions in the report which are worth our attention, however. I am sending a copy to asking whether it contains suggestions for ways in which we might further improve our management of this important and costly part of our program.

3. C/Ms

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PB

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5/12/81

Rg

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E² file

Bruce T. Johnson

Att.

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